

# Claims

- [c1] A rack and pinion system for opening and closing a damper comprising:  
a plate, having parallel opposing edges, at least one of said edges having a toothed rack defined thereon; and one or more pinion wheels, said pinion wheels having a plurality of pinion pins engaging said toothed rack, such that a rotation of said one or more pinion wheels results in the movement of said plate longitudinally with respect to said pinion wheels.
- [c2] The rack and pinion system of Claim 1 wherein each of said parallel opposing edges of said plate have toothed racks defined thereon and further having two pinion wheels, one pinion wheel disposed along each of said opposing edges of said plate.
- [c3] The system of Claim 1 further comprising one or more motors for rotating said one or more pinion wheels.
- [c4] The system of Claim 2 further comprising one or more motors for driving said pinion wheels in counter-rotating directions with respect to each other.

- [c5] The system of Claim 1 wherein each of said pinion wheels comprises:  
two wheel-shaped pinion wheel sides radially aligned in a parallel relationship with respect to each other; and  
a plurality of pinion pins, disposed between said wheel-shaped pinion wheel sides.
- [c6] The system of Claim 5 wherein said plurality of pinion pins are spaced evenly around a radius defined about said hub.
- [c7] The system of Claim 6 wherein said pinion pins are cylindrical in shape.
- [c8] The system of Claim 6 wherein said pinion pins are composed of a hardened metal.
- [c9] The system of Claim 6 wherein said racks defined in said opposing edges of said plate comprise a plurality of teeth defined said edges of said plate, the size and spacing of which correspond to the size and spacing of said pinion pins.
- [c10] The system of Claim 4 wherein said one or more motors comprises one motor and wherein said system further comprises:  
a first actuator, driven by said motor, coupled to one of said pinion wheels; a second actuator, coupled to the

other of said pinion wheels; and  
a connecting rod, coupling said first actuator and said second actuators.

[c11] The system of Claim 10 further comprising one or more flexible joints disposed between said connecting rod and said first and said second actuators.

[c12] The system of Claim 10 wherein said actuators rotate said pinion wheels in opposite directions.

[c13] The system of Claim 1 wherein said plate is composed of a metal and further wherein said toothed rack is cut directly into the metal of said plate.

[c14] The system of Claim 6 wherein said plurality of pinion pins are inwardly offset from the outer edge of said pinion wheel sides, such that a portion of said pinion wheel sides overlap said plate when said pinion pins engage said toothed rack.

[c15] In a damper for a duct having a frame mounted cross-sectionally in said duct, a plate that translates into and out of said duct to close and open said damper, and a seal cartridge mounted in said frame that engages with said blade plate when in the closed position to seal said duct, an improvement comprising:  
toothed racks defined on one or both opposing edges of

said blade plate; and

one or more pinion wheels, said pinion wheels having a plurality of pinion pins engaging said toothed racks, such that a rotation of said pinion wheels results in the translation of said plate into and out of said duct.

[c16] The improvement of Claim 15 wherein each of said parallel opposing edges of said plate have toothed racks defined thereon and further having two pinion wheels, one pinion wheel disposed along each of said opposing edges of said plate.

[c17] The improvement of Claim 15 wherein said pinion wheels comprise:  
two wheel-shaped pinion wheel sides radially aligned in a parallel relationship with respect to each other; and  
a plurality of pinion pins, disposed between said wheel-shaped pinion wheel sides and spaced evenly about said hub.

[c18] The improvement of Claim 15 further comprising one or more motors for rotating said pinion wheels.

[c19] The improvement of Claim 17 further comprising one or more motors for counter-rotating said pinion wheels with respect to each other, said counter-rotation of said pinion wheels resulting in the movement of said plate

longitudinally with respect to said pinion wheels.

[c20] The improvement of Claim 19 wherein said one or more motors comprises one motor and wherein said system further comprises:

a first actuator, driven by said motor, coupled to one of said pinion wheels;

a second actuator, coupled to the other of said pinion wheels; and

a connecting rod, coupling said first actuator and said second actuators.

[c21] The improvement of Claim 15 further comprising a hook, attachable between said blade plate and said seal cartridge, for lifting said seal cartridge out of said frame.